

The life and times of Charles Darwin

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Abstract

This contribution presents the life and times of Charles Darwin in several major intervals. It begins with an account of his early years with a description of the times in England and the events that led Darwin to join the voyage of H.M.S. *Beagle*. For Darwin, this was followed by a five-year data-gathering phase during the voyage on the *Beagle* in which he encountered the world – the vast “natural laboratory” that exposed him to the rich diversity of the environment, and life and processes from geology, to coral reefs, to vegetation, from many climatic regions, and from many physiographic settings, all of which were to provide him with data and information from which he was to derive ideas for his book, *On the Origin of the Species*. The next phase, the post-*Beagle* years, was the 22-year period of the writing of *On the Origin of the Species* when his life’s work and observations came to fruition. This was followed by the public uproar after publication of his book, when he was faced with antagonism, derision, criticism, and hostility from all sectors of society, as well as support and promotion of his ideas. Darwin’s final years saw him in poor health and having to deal with the events following the publication of his book while continuing his investigations into natural selection as the mechanism for evolution. These major natural intervals or periods capture the essence of the main and influential events around Darwin’s life and times.

Keywords: Charles Darwin, H.M.S. *Beagle*, *On the Origin of Species*; natural selection; evolution

Introduction

Charles Darwin lived during the Victorian Era, a period of great social, scientific, and technological change. The Industrial Revolution of that time brought blessings and hardship: The Great Exhibition, the first World’s Fair, in 1851 exhibited the greatest innovations of the 19th century; the population in the United Kingdom increased by 50% during the last five decades of that century; the Great Famine of 1845 brought starvation to millions in Ireland (the Potato Famine), Scotland and England and the subsequent emigration of over one million Irish people to Canada, the United States of America, and Australia; the Corn Laws were repealed in 1846 thus opening the way for free trade; the Mines Act of 1842, which banned women and children from working in the mining industry, was enacted; and the scarcity of housing resulted in overcrowding and growth of the slums. The Victorian Era was also a period when, with the rise of the middle class, many Victorian gentlemen developed an interest in the study of natural science. Carolus Linnaeus’ taxonomy was well-established, geology was being explored and vigorously debated, and the Church was still adhering to a literal interpretation of the Bible, particularly the account of The Creation as set down in Genesis which would later become the basis for the Church’s opposition to Darwin’s theory of evolution.

This paper will trace Darwin’s life from his early years at his family’s home in Shrewsbury, thence to his

university years at Edinburgh and Cambridge where he would read books that would stimulate his interest in the sciences, and he would meet people who would have a lasting influence on the direction and conduct of his scientific enquiry. The fortuitous invitation to take up the post of ship’s naturalist and companion to Capt. FitzRoy on the second surveying voyage to South America of H.M.S. *Beagle*, which would provide Darwin with the opportunity fulfill a long-held desire to visit South America and other parts of the world, will be examined. The important post-*Beagle* years will be described, a time following the cataloguing of the specimens Darwin had collected during the voyage, when he moved to London and became an active and respected member of the scientific community, and his subsequent marriage in 1839 and move to Down, Kent in 1842. The publication of *On the Origin of Species* (Darwin 1859) and the responses of the scientific world, the Church, and the public to this book will be examined, followed by a brief description of Darwin’s productive final years.

The structure of this contribution, in presenting the life and times of Charles Darwin beginning with an account of his early years, then the *Beagle* voyage, followed by the post-*Beagle* years that included the writing of *On the Origin of Species* and the consequences following publication of his book, and finally, Darwin’s last years, needs some explanation. Generally, biographies on Charles Darwin tend to be substantially chronological, following his life and the events therein; this contribution also is chronological, of course, but I have separated the story of Darwin’s life into major natural intervals or periods which I think capture the essence of the main and influential events around his life

and times. In this context, this contribution departs from many other chronological treatments of Darwin's biography, and others that focus on specific aspects of, or themes in his life and contributions in that it identifies four major time blocks in which the critical events unfolded, and provides a story of Charles Darwin's life and times from a perspective of these four major periods in his life. The reasons for this approach are outlined below.

The chronicle of the events during the life of Charles Darwin provides a context of why and how he eventually undertook the journey on the *Beagle*, and perhaps insights into how his writings developed in that it provides a social and political flavour to the events that shaped his thinking and ethos, particularly, for instance, the "revolution" in the Victoria Era where middle-class gentlemen were free to pursue their scientific interests, a factor that is relevant in that Darwin was living and exploring at a time when such activities were socially acceptable. Similarly, the Potato Famine in Ireland in 1845 and the subsequent migration of many people from Ireland helped provide Darwin with a context for an understanding of the struggles of populations to survive, something that would have influenced him in the writing of *On the Origins of Species*. For societies where life was not a struggle, or for those living in privileged society, there may not have been the arena of "struggle" which would provide important "grist for the mill" in the writing of the *On the Origins of Species*. In fact, Darwin lived in times where there were hardships, and I am of the opinion that these influenced him in the concept of species and their struggles to survive. Also, the times of Darwin were those when women were being emancipated. He would also have been aware of the works of Malthus at this time, and its implications for the struggle of communities.

The voyage of the H.M.S. *Beagle* was a very important time as it was Darwin's data-gathering phase, in which he interfaced with the world at large, i.e., the vast "natural laboratory" that was to expose to him the rich diversity of the environment and life and processes: from geology, to coral reefs, to forests, to species richness, from many climatic regions, and from many physiographic settings. It was an experience that would have truly created for him a multidisciplinary thinking in his science and one that, I believe, was essential to the writing of *On the Origins of Species*. For instance, witnessing an earthquake and its attendant effects and its scientific implications would not have been possible if he had stayed home in England. The next phase was important because the long period spent in the writing of *On the Origins of Species*, allowed him time for the gestation and refinement of ideas; over twenty years were spent thinking through concepts and analysing data to arrive at the unique and refined Theory of Evolution. Contrast that period with what the average postgraduate student would do today – two years of focussed data-collection, another year analysing the data, and finally, the conceptualising and writing up of the results into a thesis.

The last phase, too, was important as it was a time of hostility, rejection, acceptance, and adulation, from all sections of society, towards Darwin and his work. Like many authors before him who wrote tomes that

challenged the prevailing paradigms (e.g., Giordano Bruno, and Galileo Galilei), Darwin was subjected to criticism, hostility and rejection. His book had major implications for Theology and general social understanding, and of course, Man's concept of his place in the Universe. While Darwin inadvertently and implicitly challenged established paradigms (and this was not without scientific, social, and theological fallout), many scientists and learned persons accepted his ideas and provided support in scientific circles.

The major milestones in Charles Darwin's life are summarised in Figure 1.

The early years

Charles Robert Darwin was born at Mount House, Shrewsbury, in Shropshire, England on the 12th February, 1809, the fifth of six children of a local doctor. Darwin was the grandson of the physician, natural scientist, and poet, Erasmus Darwin and thus was born into the upper class of British society (Price 2008). In 1818, the year following the death of his mother, Darwin was sent to Shrewsbury School as a boarding student. Darwin's interests in natural history and chemistry were developing during these early years, however he did not excel in the strictly classical education afforded by the school, of which Darwin writes: "Nothing could have been worse for the development of my mind than Dr Butler's school ... as a means of education to me [it] was simply a blank" (Darwin 1887). It was at this time that Darwin's desire to travel to remote countries was initiated by reading a school-friend's book on the wonders of the world. Darwin recalls that "... I believe that it was this book first gave me a wish to travel in remote countries, which was ultimately fulfilled by the voyage of the *Beagle*" Darwin (1887).

In 1825, at 16 years of age, Darwin entered the University of Edinburgh to study medicine (Barlow 1958) however, he did not complete his studies, but nonetheless it is an important period in Darwin's life. He forged a lasting friendship with Professor Robert Grant who taught zoology and it was from Grant that Darwin learned about Lamarck and transmutation (a term coined by Lamarck and later replaced by the term "evolution" (Lamarck 1801). During his sojourn in Edinburgh Darwin read several influential books including his grandfather's book, *Zoonomia: or the Laws of Organic Life* (Darwin 1794–96) wherein Erasmus argued that every living organism on the Earth had descended from one common ancestor, Lamarck's *Système des Animaux sans Vertèbres* (Lamarck 1801), and Paley's (1802) *Natural Theology, or Evidences for the existence and attributes of the Deity collected from the appearances of nature* in which Paley explained adaptation as God acting through the laws of Nature. While in Edinburgh Darwin forged a friendship with William MacGillivray, the Curator of the University Museum, from whom Darwin learned about anatomy, botany, and making notes on observations. With his developing interest in natural science, Darwin began to keep field notebooks, and joined an undergraduate science club, the Plinian Natural History Society, where, on 27th March 1827, he presented a talk on two marine invertebrates, *Flustra* (a bryozoan) and *Pontabdelta muricata* (Skate-leech) (Barrett 1977; Burkhardt 2008; Nicholas & Nicholas 2008).

While his father hoped that Darwin would continue in the family tradition of practicing medicine, Darwin did not complete his medical studies as he was unable to tolerate the sight of blood, nor did he find the classes interesting.

Robert Darwin, aware that his son did not want to become a physician, proposed that he should study theology to become a clergyman (Barlow 1958). To that end, in January 1828, Darwin entered Christ's College, Cambridge where he enrolled in a three-year Bachelor of Arts degree as a precursor to studies in Theology (Price 2008). At Cambridge, as at Edinburgh, Darwin's interests were clearly outside the established academic curriculum. He met Reverend Professor John Henslow, botanist, naturalist, and theologian who encouraged his interest in natural history for which there was no degree offered at that time (Burkhardt 2008). Henslow became Darwin's tutor in geology (Geikie 1909), and his friend and mentor with whom he maintained a constant correspondence for many years. He encouraged Darwin to broaden his study of the natural world, and recommended John Herschel's *A Preliminary Discourse on the Study of Natural Philosophy* (1831) which, in part, advocated the use of observation and experimentation in scientific research. A letter to Henslow from Darwin reveals that, as early July 1831, Darwin had read von Humboldt's *Personal Narrative of Travels to the Equinoctial Regions of the New Continent during the Years 1799–1804* (in 7 volumes) (1814–29), the book that inspired him to travel to the New World (Burkhardt 2008).

It was at Cambridge that Darwin also met geologist, Adam Sedgwick, Woodwardian Professor and Chair of Geology, through whom Darwin became interested in geology (Price 2008). In 1831, Darwin accompanied Sedgwick on a two-week geological field trip to Wales, during which he became conversant with the methods of recognising and interpreting fossils and rock formations, field methods which he would use and later refine during the voyage of H.M.S. *Beagle* (Barlow 1958). Darwin completes his undergraduate studies after undertaking units in geology, and graduates in 1831.

The voyage of H.M.S. *Beagle*

The five-year voyage of H.M.S. *Beagle* was to set Darwin irrevocably on the path to becoming a distinguished naturalist, an experience which, in his autobiography, he acknowledged "... has been by far the most important event in my life and has determined my whole career" (Barlow 1958), and will establish Darwin as an eminent geologist whose observations and theories would support Charles Lyell's uniformitarian theories (Desmond & Moore 1991).

Darwin's journey began on the 30th August 1831, several months before H.M.S. *Beagle* was due to commence its voyage, when he received a letter from Henslow informing him that Captain FitzRoy R.N. was seeking an unofficial, unpaid naturalist to sail with H.M.S. *Beagle* on its survey voyage to the south coast of South America, a voyage that was expected to last two years (Burkhardt 2008; Price 2008). Darwin was eager to take up the position, and on Henslow's recommendation, Darwin was invited to travel on H.M.S. *Beagle*. As

Darwin must pay his own way, Darwin needed his father's financial assistance but faced opposition from him. Josiah, Darwin's uncle, interceded and Darwin's father eventually agreed that Darwin could go on the voyage, and further that he would pay all Darwin's costs that would be incurred during the voyage (Price 2008). Having received his father's permission, Darwin left England on board the H.M.S. *Beagle*, on the 27th December 1831.

A full description of the voyage of H.M.S. *Beagle*, the subject of numerous books, is not possible here, however a chronology of the voyage is provided in Table 1, followed by comments on several places of call where Darwin embarks on excursions and undertakes field work.

After two weeks of continuous sailing, on 16th January 1832, H.M.S. *Beagle* arrived at the Cape Verde Islands, an archipelago of volcanic outcrops approximately 400 miles off the coast of West Africa where the *Beagle* was to remain for twenty-three days (Price 2008). Darwin disembarked at St. Jago, and welcomed the respite from the chronic seasickness which was to afflict him throughout the voyage. He wrote to his father that: "St. Jago has afforded me an exceedingly rich harvest in several branches of Nat: History" (Burkhardt 2008). The Cape Verde Islands also provide Darwin with his first opportunity to explore a volcanic island, and it is here that Darwin conceived the idea to write a book on geology (Moorehead 1969).

Leaving the Cape Verde Islands, the *Beagle* reached Brazil six weeks later and landed at the ancient town of Bahia where Darwin "... in earnest strolled in the forests of the new world" (Burkhardt 2008). Darwin at last is fulfilling his desire to see the New World which was inspired by his reading of Alexander von Humboldt's *Personal Narrative* (1814–29).

The next two years are spent surveying the south-eastern and southern coastline of South America during which time Darwin spent many weeks ashore. Rio de Janeiro presented Darwin with an opportunity to begin his botanical research and collection of specimens. He took up rented quarters in Botofogo Bay and within days visited a plantation 100 miles from the town, passing through tropical forest which, with its profusion of flora and fauna, was a source of delight to Darwin (Moorehead 1969).

Darwin's observations were not restricted to the flora and fauna of South America. In Argentina, he undertook an excursion to the pampas where he observed not only the wildlife but the life-style of the *gauchos* who spent much of their time in the saddle, and noted, in particular, their hunting skills with the *lazo* and *bolas*. It was on the pampas that Darwin observed two species of rhea which, in *On the Origin of Species*, he would use as an example of two separate species co-existing in the same place while remaining distinct (Darwin 1859). Travelling south, the *Beagle* landed in Tierra del Fuego, the indigenous inhabitants of which Darwin described in a letter to Henslow on 11th April 1833: "The Fuegians are in a more miserable state of barbarism than I ever expected to see in a human being" (Burkhardt 2008). However, despite his unfavourable observations of the Fuegians, he found the geology "very interesting – the country is non-

Charles Darwin: his life and times

Darwin's contribution in his publication, *On the Origin of Species by Means of Natural Selection*, was a major event in the history of science, and the influence of his theory of evolution had far-reaching effects - not only biologically, but also in other arenas of science, as well as socially, and theologically. This contribution examines the life and times of Darwin listing and briefly describing what I consider to be the milestone events in his life. From 1809, the year of his birth, to 1882, the year of his death, I have divided Darwin's life into six phases: 1. his early years dealing with his childhood and college years; 2. the historic voyage of *H.M.S. Beagle* during which he collected much of the data that were to help develop the theory of evolution; 3. the post-*Beagle* years when he published some of the results obtained during the voyage of the *Beagle*, continued further research and publishing, moved into the scientific community, and married; 4. Published *On the Origin of Species by Means of Natural Selection*; 5. the period immediately after publication of the book when there was intense debate and controversy about the theory and its implications, which continue to this day; and 6. His final years wherein he continues research and publishing until his death.



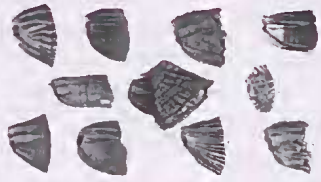
1809-31 Early Days

- 1809 Born 12th February in Shrewsbury, Shropshire, England; fifth child of a local doctor, and grandson of the physician, natural scientist and poet, Erasmus Darwin who was one of the first writers to suggest that existing species might have evolved from earlier forms of life; shows an early interest in natural history
- 1818 Darwin's mother dies; Darwin sent to Shrewsbury School
- 1825 Attends University of Edinburgh to study medicine; does not complete studies
- 1827 Enters Christ's College, Cambridge to study theology; meets Prof. John Henslow, botanist and naturalist; Darwin extends his knowledge of natural history and spends many hours on the seashore studying barnacles; becomes interested in geology during a visit to Wales; graduates in 1831
- 1831 On Henslow's recommendation, Darwin is invited to travel on *H.M.S. Beagle* on its second surveying voyage as naturalist and companion to Captain Robert FitzRoy

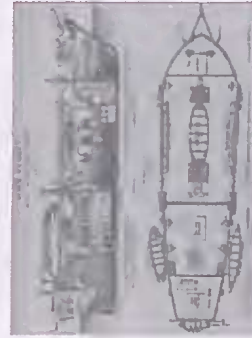
1831-36 The Voyage of H.M.S. Beagle

- 1831 27th December: *H.M.S. Beagle* leaves England
- 1832 16th January: Arrives Cape Verde Islands and at St. Jago discovers rock cliffs embedded with seashells
- 28th February: Arrives at Bahia, Brazil; in the rain forests, Darwin collects exotic insects
- 1832-34 Two years spent surveying the coast of southern South America and the Falkland Islands, the main objective of the expedition; Darwin observes the indigenous people of Terra del Fuego
- 1835 16th September to 20th October: Galapagos Islands; first geological description of Galapagos islands; Darwin perceives the significance of the linear arrangement of the volcanoes on the islands; collected many specimens of closely-related finches; Darwin later realises that similar and therefore closely-related species frequently occur in adjacent regions
- The *H.M.S. Beagle* crosses the Pacific Ocean, landing in Tahiti on 15th November and New Zealand on 21st December. Observations of coral islands and volcanic islands provide material for two books
- 1836 12th January: Arrives at Sydney Cove; visits Sydney and the Blue Mountains; travels extensively in Tasmania; stops at King George Sound in W.A.; Darwin describes the geology of Australia as 'magnificent, astounding, and unique' (his formal description of the geology of New South Wales appears as Chapter 4 of *Volcanic Islands*); discovers two new species of brachiopod; makes detailed observations of many species of trees in Australia, attributing their general appearance of 'infertility' to '... a great deficiency of rain and running water'; Darwin is intrigued by Australia's fauna, his observations leading him to make important conclusions about animals in different parts of the world having similar adaptations but obviously belonging to different species (now known as convergent evolution); observes Aboriginal people and remarks on their hunting skills, however he does not fully appreciate the richness of the hunter-gatherer lifestyle, placing them 'some few degrees higher in civilisation' to the 'Feuigians' (the indigenous people of Terra del Fuego) who he considers barbaric
- 2nd October: arrives back in England and is reunited with his family

Barnacles from Darwin's books



Plan of H.M.S. Beagle



Galapagos finches showing different beaks



1837-58 The post-Beagle Years

- 1837 July: Darwin opens his Red Notebook which reveals his first speculations on the transmutation of species, thus beginning the process that would lead to the theory of natural selection, the first comprehensive outline of which was written in 1842
- 1838-42 As editor, Darwin oversees the publication of *The Zoology of the Voyage of H.M.S. Beagle* in five parts - *Birds* (by John Gould), *Fish* (by Leonard Jenyns), *Fossil Mammalia* (by Owen), *Mammalia* (by G. R. Waterhouse), and *Reptiles* (by Thomas Bell)
- 1839 January: Marries his cousin, Emma Wedgwood; first child born at the end of that year; first edition of *Journal of Researches* is published
- 1842-46 The extensive geological observations and notes Darwin made during the voyage on *H.M.S. Beagle* result in the publication of three volumes, one each on coral reefs (1842), volcanic islands (1844), and South America (1846)
- 1847 March: Moves to London where he sees his future with the scientific elite; becomes involved with the Geological Society of London where, as a supporter of Lyell, is acknowledged as one of the elite group entitled to speak with authority on theoretical issues; ill-health prompts the purchase of, and subsequent move to, the house at Down in Kent
- 1858 Daughter, Anne, dies; Darwin's faith is tested; becomes an agnostic
- 1st July: The Darwin-Wallace paper - *On the Tendency of Species to form Varieties; and on the Perpetuation of Varieties and Species by Natural Means of Selection* - was communicated to the Linnean Society of London by Sir Charles Lyell, J. D. Hooker, and others

1859 On the Origin of Species by Means of Natural Selection

24th November: *On the Origin of Species by Means of Natural Selection* is published; five editions follow (1860, 1861, 1866, 1869 and 1872), each edition updated with new information, and answers to questions raised by critics; title modified to *The Origin of Species* in the sixth edition

On the Origin of Species provides a plausible mechanism to explain how species can change: natural selection. In providing this mechanism, Darwin succeeds where his grandfather, Erasmus, had failed. Embedded in this comprehensive work is the idea of a species as a population; speciation in which Darwin stresses the importance of isolation; sexual selection; and intercrossing of individuals, amongst others

Opinion of Science, Church and Public

Darwin's theory of evolution challenged most biologists who thought of species as fixed and eternal groups, ordained by God. They thought that each species had its essential defining characteristics, tacitly assumed to be those possessed by the original member of each species. Many biologists failed to see how wings, for example, could have arisen except by a sudden major modification.

However, Darwin had the support of many including Thomas Huxley who engaged in vigorous debates with Darwin's critics, e.g. Bishop Wilberforce and comparative anatomist, theistic evolutionist and leading opponent of Lamarckism, Richard Owen. Another of Darwin's supporters, Asa Gray, Professor of Botany at Harvard, was the major champion of Darwinism in America. William Thomson (later Lord Kelvin) indirectly argued against natural selection also, by attacking Lyell's uniformitarian geology. Darwin had relied on the vast amounts of time allowed by Lyell's geology because he believed that natural selection was an immensely slow process.

The popular press of the time is scoffing and publishes caricatures of Darwin. Darwin's friendship with Richard FitzRoy, who believes in the literal interpretation of the Bible, breaks down, and Darwin's long friendship with Henslow is also adversely affected ... the debate continues to this day!

The Final Years

- 1870s Darwin's health, which has been poor for many years, improves; continues work on botanical projects; studies the small-scale effects that were most directly illuminated by his theory of local adaptation due to natural selection
- 1881 Publishes his last major work, a book on earthworms.
- 1882 19th April: Darwin dies at his home in Down, Kent, and is buried in Westminster Abbey



Figure 1. Summary of the major milestones in Charles Darwin's life.

Table 1

Chronology of the voyage of H.M.S. *Beagle* with details of Darwin's excursions (after Moorehead 1969)

Date/Period	Place of call
27 December 1831	H.M.S. <i>Beagle</i> departs from Plymouth Sound, England
1832	
18 th January to 8 th February	Arrives at Cape Verde Islands
28 th February to 18 th March	Bahia (now Salvadore) in Brazil
8 th to 23 rd April	Excursions to various estates inland
4 th April to 5 th July	Rio de Janeiro, Brazil
26 th July to 19 th August	Montevideo, Uruguay
6 th September to 17 th October	Bahia Blanca, Argentina
2 nd to 26 th November	Montevideo, Uruguay
16 th December to 26 th February 1833	Tierra del Fuego, Argentina
1833	
1 st March to 6 th April	Falkland Islands
28 th April to 23 rd July	Maldonado, Uruguay
3 rd to 24 th August	Mouth of the Rio Negro, Brazil
11 th to 17 th August	Excursion from El Carmen to Bahia Blanca
24 th August to 6 th October	Surveying the coast of Argentina
8 th to 20 th September	Excursion from Bahia Blanca to Buenos Aires
6 th to 19 th October	Maldonado, Uruguay
27 th September to 20 th October	Excursion to Santa Fe and along the Parana
21 st October to 6 th December	Montevideo, Uruguay
14 th to 28 th November	Excursion to Mercedes, Argentina
23 rd December to 7 th January 1834	Port Desire, Argentina
1834	
9 th to 19 th January	Port Saint Julian, Argentina
29 th January to 7 th March	Tierra del Fuego, Argentina
10 th March to 7 th April	Falkland Islands
13 th April to 12 th May	Santa Cruz river, Argentina
18 th April to 8 th May	Excursion up the Santa Cruz river
28 th June to 13 th July	Chiloe, Chile
31 st July to 10 th November	Valparaiso, Chile
14 th August to 27 th September	Excursion into the Andes
21 st November to 4 th February 1835	Chiloe and Chonos archipelago
1835	
8 th to 22 nd February	Valdivia, Chile
4 th to 7 th March	Concepcion, Chile
11 th to 17 th March	Valparaiso, Chile
13 th March to 10 th April	Excursion from Santiago across the Andes to Mendoza
27 th March to 17 th April	In the neighbourhood of Concepcion
17 th April to 27 th June	Chilean coast
27 th April to 4 th July	Excursion to Coquimbo and Copiapo, Chile
12 th to 15 th July	Iquiqui, Peru
19 th July to 7 th September	Callao, Peru
16 th September to 20 th October	Galapagos Islands
15 th to 26 th November	Tahiti
21 st to 30 th December	New Zealand
1836	
12 th to 30 th January	Sydney, Australia
2 nd to 17 th February	Hobart, Australia
3 rd to 14 th March	King George Sound, Australia
2 nd to 12 th April	Cocos (Keeling) Islands
29 th April to 9 th May	Mauritius
31 st May to 18 th June	Cape of Good Hope, South Africa
7 th to 14 th July	St Helena
19 th to 23 rd July	Ascencion Island
1 st to 6 th August	Bahia, Brazil
12 th to 17 th August	Pernambuco, Brazil
2 October 1836	Voyage ends with the <i>Beagle's</i> arrival at Falmouth, England

fossiliferous and a common place succession of granitic rocks & Slates: attempting to make out the relation of cleavage, strata &c. &c. was my chief amusement" (Burkhardt 2008). Before leaving South America, the *Beagle* sailed up the west coast of South America. While anchored off the coast of Chile near Chiloe Island, Darwin and FitzRoy observed two volcanic eruptions on the mainland, and later, in the town of Concepcion, Darwin saw the devastation caused by an earthquake, the epicenter of which was located near the town (Darwin 1844). Darwin recorded that: "since the great Earthquake ... the Island of S. Maria [a volcanic island off the Chilean coast] has been elevated 10 feet: Capt. FitzRoy found a bed of Muscles [sic] with putrid fish that many feet above high water mark" (Burkhardt 2008).

After leaving South America, the crossing of the Pacific Ocean began. Arriving in the Galapagos Islands on 16th September, the next thirty-six days were spent sailing between the different islands of the archipelago. Darwin's first reaction to their volcanic landscape was not positive, however his initial impression was revised as his Journal records: "The natural history of this archipelago [the Galapagos Islands] is very remarkable: it seems to be a little world within itself; the greater number of its inhabitants, both vegetable and animal, being found nowhere else" (Darwin 1839). Darwin discovered that the islands were formed in relatively recent times, a process that was still continuing, and made the first geological description of them (Darwin 1844). One of the most important fauna that Darwin observed in the Galapagos Islands were the thirteen species of finch, John Gould's illustrations of which would show the differences in size and shape of beak which were adaptations to food source (Gould 1841; Darwin 1859). Darwin would later propose that the different species of finch were descendants of a common ancestor, and that closely-related species often occur in adjacent regions (Darwin 1859).

After leaving the Galapagos Islands, H.M.S *Beagle* visited Tahiti and New Zealand in November and December, 1835, then proceeded to Australia, arriving at Sydney Cove, New South Wales on 12th January, 1836. The other regions visited in Australia were Tasmania where Darwin travelled extensively, and King George Sound in Western Australia. Whilst in Australia, Darwin made detailed observations of many species of trees, attributing their general appearance of "infertility [due to] ... a great deficiency of rain and running water" (Darwin 1839). Darwin was intrigued by Australia's fauna, his observations leading him to make important conclusions about animals in different parts of the world having similar adaptations but obviously belonging to different species – now known as convergent evolution (Darwin 1839). He described the geology of Australia as "magnificent, astounding, and unique" with his formal description of the geology of New South Wales appearing as Chapter 4 in *Geological observations on the volcanic islands visited during the voyage of H.M.S. Beagle* Darwin (1844). In Tasmania, 4 km south of Hobart, Darwin discovered two species of brachiopod which he termed "Terebratula". These were later identified as new species and named by G. B. Sowerby, *Producta brachythaerus* and *Spirifera subradiata* (in appendix to Darwin 1844). Darwin also observed Aboriginal people

and remarked on their hunting skills, however he did not fully appreciate the richness of their hunter-gatherer lifestyle, placing them "some degrees higher in civilization ... to the Fuegians" who he considered to be barbaric (Nicholas & Nicholas 2008). H.M.S. *Beagle* left Australian waters on the 14th March, 1836 and, after making landfall several times, arrived back in England on the 2nd October 1836.

The record of Darwin's voyage on H.M.S. *Beagle* first appeared as the third volume (Journal and Remarks) of *Narrative of the Surveying Voyages of His Majesty's Ships Adventure and Beagle* (FitzRoy 1839), later published in its own right as the *Journal of Researches into the Geology and Natural History of the Various Countries Visited by H.M.S. Beagle under the Command of Capt. FitzRoy, R.N.* (Darwin 1839), with a second edition published in 1845 (Darwin 1845); in its current form it is known as *The Voyage of the Beagle*.

The post-Beagle Years

The post-*Beagle* years begin with Darwin's return to England in 1836, and end with the presentation of the joint Darwin-Wallace paper read to the Linnean Society in 1858. These two important decades in Darwin's life started in Cambridge where he spent several months, followed by his move to London, marriage to Emma Wedgwood, and his entry into the scientific community. It was a time when he made influential friends who would later champion his theory of evolution after the publication of *On the Origin of Species*.

The five-year voyage of the *Beagle* ended in October 1836. After a brief sojourn with his family in Shrewsbury, Darwin travelled to Cambridge and spent several months cataloguing the specimens from the voyage that had been stored by Henslow. In March 1837 Darwin moved to London where he perceived his future to lie with the scientific elite. It was a time when there was geological debate between two camps, the catastrophists and the uniformitarians, of which Sedgwick was a leading member in the first instance, and Lyell, with whom Darwin was aligned, in the second (Bowler 1990). On Lyell's nomination, Darwin was accepted as a member of the Geological Society of London where he was welcomed as a geologist who could speak on equal terms with men of science, and a member of a select group entitled to speak with authority on theoretical issues (Bowler 1990). Darwin was elected a Fellow of the Royal Society in January, 1839, and Vice-President of the Geological Society of London in 1843; he also became a member of The Royal Geographical Society, and the Zoological Society of London. At this time Darwin was appointed to a committee to "consider the rules by which the Nomenclature of Zoology may be established on a uniform and permanent basis" (Darwin *et al.* 1842).

In January 1839, Darwin married his cousin, Emma Wedgwood. Their first child, William, was born at the end of that year. Nine more children are to follow. Darwin's ill-health prompted the purchase of, and subsequent move to, the house at Down in Kent in 1842.

Over the next few years Darwin wrote prolifically, drawing on material and observations made during the voyage of H.M.S. *Beagle*. On the invitation of FitzRoy,

Darwin contributed his *Journal and Remarks 1832–1835* which are published in 1838 as the third volume of *Narrative of the Surveying Voyages of His Majesty's Ships Adventure and Beagle* (FitzRoy 1839), later republished in its own right as the *Journal of Researches into the Natural History and Geology of the Countries Visited during the Voyage of H.M.S. Beagle Round the World* (later known under the title: *The Voyage of the Beagle*). In addition, between 1838 and 1843, Darwin, as editor of *The Zoology of the Voyage of H.M.S. Beagle*, supervised its publication in five parts: 1. *Fossil Mammalia* (Owen 1840); 2. *Mammalia* (Waterhouse 1839); 3. *Birds* (Gould 1841); 4. *Fish* (Jenyns 1842); and 5. *Reptiles* (Bell 1843).

The extensive geological observations and notes that Darwin had made during the voyage provided the basis for three books, the short titles of which are: *The Structure and Distribution of Coral Reefs* (published in 1842); *Geological Observations on the Volcanic Islands Visited During the Voyage of H.M.S. Beagle* (published in 1844); and *Geological Observations on South America* (published in 1846). The years between 1846 and 1854 were devoted to his research on barnacles which resulted in two monographs (each in two volumes): *Living Cirripedia* (Darwin 1851a; Darwin 1854a) and *Fossil Cirripedia* (Darwin 1851b and 1854b).

Darwin, Wallace, and a theory of evolution

Alfred Russel Wallace (1823–1913) was a British naturalist and biologist who had travelled extensively in South America and the Malay Archipelago in the late-1840s and 1850s collecting zoological and botanical specimens for sale in Britain. It had been a decade since Darwin returned to England, and a time when Darwin was slowly formulating his theory on evolution. In a letter to Hooker dated 11th January, 1844, Darwin revealed that since his return to England he had been "... engaged in a very presumptuous work ..." and that he was almost convinced that species were not immutable, and that his conclusions were not dissimilar to those of Lamarck "... though the means of change are wholly so" (Burkhardt 2008).

Both Darwin and Wallace had read Malthus' *An Essay on the Principle of Population* (1798). Darwin's *Autobiography* records that he read Malthus' essay in October 1838 – he comments:

I happened to read for amusement Malthus on Population, and being prepared to appreciate the struggle for existence which everywhere goes on, from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The result would be the formation of a new species (Barlow 1958)

Also in 1838 Darwin recorded in his Notebook (designated "D") his first reference to the principle of population, and that Malthus' concept of the 'struggle for existence' played a major role in leading his thoughts towards natural selection (Bowler 1990). This is borne out in a letter from Darwin to Wallace six months after the publication of *On the Origin of Species*:

You are right, that I came to the conclusion that selection was the principle of change from study of domesticated productions; & then reading Malthus I saw at once how to apply this principle (Burkhardt 2008)

Wallace also had been formulating a theory of evolution along similar lines to Darwin. In 1855 Wallace published a paper entitled: "On the law which has regulated the introduction of new species" in *Annals and Magazine of Natural History* (Wallace 1855). The law proposed that every species has come into existence coincident both in time and space with a pre-existing, closely allied species. At this time Darwin and Wallace were corresponding regularly; Darwin received a letter from Wallace dated 10th October, 1856, and in his reply (dated 1st May 1857) acknowledged that he had also read Wallace's paper, and "... can plainly see that we have thought much alike & to a certain extent have come to similar conclusions" (Burkhardt 2008). In this same letter Darwin wrote that he was preparing his work for publication but did not think that the book would be published for at least two years (Burkhardt 2008).

Lyell urged Darwin, who had been developing his theory for over twenty years, to write up his theory for publication to establish precedence (Bowler 1990). Darwin received a manuscript from Wallace in June 1858 in which a principle of natural selection was proposed that was almost identical to Darwin's idea, precipitating a crisis in Darwin. On the advice of Lyell and Hooker, a simultaneous publication of Wallace's paper and a short extract of Darwin's own to ensure propriety was arranged (Bowler 1990). Thus, on the 1st July 1858 the Darwin-Wallace paper – *On the Tendency of Species to form Varieties; and on the Perpetuation of Varieties and Species by Natural Means of Selection* – was communicated to the Linnean Society of London by Sir Charles Lyell and J. D. Hooker, and published in the *Proceedings of the Linnean Society*, Vol. 3 1858, pp. 45–62. The paper consisted of: 1. a letter of introduction by Charles Lyell and Joseph D. Hooker; 2. an unpublished Work on Species by C. Darwin, Esq. consisting of a portion of a chapter entitled, "On the Variation of Organic Beings in a state of Nature; on the Natural Means of Selection; on the Comparison of Domestic Races and true Species"; 3. an abstract of a letter from C. Darwin, Esq. to Prof. Asa Gray (Boston, U.S.) dated 5th September, 1857; and 4. the manuscript "On the Tendency of Varieties to depart indefinitely from the Original Type" (known as the Ternate Paper of 1858) by Alfred Russel Wallace.

On the Origin of Species by Means of Natural Selection

In Darwin's time, the concept of evolution by descent was not a new concept, dating at least from the classical Greek philosophers. Leakey (1979) states there were no fewer than twenty predecessors who had written on aspects of evolution before Darwin, for example, in the early 18th Century Carolus Linnaeus (1707–1778) postulated limited mutability of species by descent and hybridization, and coined the term "transmutation". Towards the end of the century, Erasmus Darwin (1731–1802), and the French naturalist, Jean Baptiste de

Lamarck (1744–1829) were the main proponents of evolution (transmutation) at a time when the majority of naturalists were concerned with species identification (Leakey 1979; Bowler 1990). Later, Chambers, publishing anonymously in England, proposed a theory which argued for an evolutionary view of life similar to that proposed by Lamarck (Chambers 1844).

On the 24th November, 1858, Darwin's theory of evolution was published under the title *On the Origin of Species by Means of Natural Selection: or the Preservation of Favoured Races in the Struggle for Life*. Five editions follow (1860, 1861, 1866, 1869, and 1872), each updated with new information, with answers to questions raised by critics. The title is modified to *The Origin of Species* in the sixth edition.

Modern evolutionary theory derives from Darwin with *On the Origin of Species* providing a plausible mechanism to explain how species can change, that is, *natural selection*. In providing this mechanism, Darwin succeeded where his grandfather, Erasmus Darwin, and others had failed (Leakey 1979). Embedded in Darwin's comprehensive work is the concept of descent by modification which could result in the appearance of new species, the idea of a species as a population; speciation in which Darwin stressed the importance of isolation; sexual selection; and intercrossing of individuals (Leakey 1979).

Opinion of Science, Church and Public

The publication of *On the Origin of Species* aroused intense interest in all sectors of society, not only in England but also in the United States, and was the focus of heated debate.

Science

Darwin, who was living in Down, though physically removed from the centre of debate, was not insulated from the controversy that raged over his theory; he wrote to Lyell on 10th December 1859 to say that he had heard that "Herschel says my Book is the law of higgledy-pigglety" a comment that Darwin believed was contemptuous, and which, if it was true, was a "great blow and discouragement" (Burkhardt 2008).

However, Darwin had the support of many notable people in science, including botanist, Joseph Hooker, and naturalist, Thomas Huxley (who was later dubbed "Darwin's bulldog"), who engaged in vigorous debates with Darwin's critics, namely Bishop Samuel Wilberforce of Oxford (at the 1860 Oxford evolution debate – "the Great Debate"), and comparative anatomist, theistic evolutionist, and leading opponent of Lamarckism, Richard Owen (Leakey 1979; Desmond & Moore 1991). Owen (1860) was responsible for a damaging review of *On the Origin of Species* in the *Edinburgh Review* in which he labelled transmutation as nonsense, a comment which drew public castigation from Huxley.

Another of Darwin's supporters, Asa Gray, Professor of Botany at Harvard University, was the champion of Darwinism in America, and on the Continent, William Haeckel, a German biologist, became a great promoter of Darwin's theory (Quammen 2008).

The Church

The responses to Darwin's theory by theologians varied widely. Prof. Adam Sedgwick, a geologist and theologian who followed the natural theology tradition, accepted Darwin's idea of change over time but disagreed about the mechanism (Clark & Hughes 1890). On the other hand, Charles Kingsley, a country rector and novelist who was described by Huxley as "an excellent Darwinian to begin with", praised *On the Origin of Species* and wrote that "... if you be right I must give up much that I have believed" (Desmond & Moore 1991).

Darwin's friend and mentor, Henslow wrote to Rev. Jenyns (his brother-in-law) and said that "the Book is a marvellous assemblage of facts & observations – & no doubt contains much legitimate inference – but it pushes *hypotheses* (for it is not real *theory*) too far", however Henslow eventually dissented and protested to the papers when he was linked with Darwin's supporters (Desmond & Moore 1991), no doubt a great disappointment to Darwin.

Across the Atlantic Ocean in America, Charles Hodge, Principal of Princeton Theological Seminary, was affronted by Darwin's theory of natural selection, arguing that Darwinism was, in essence, atheism, and launched a sustained assault on Darwin's theory over a number of years (Hodge 1874).

The Public

The popular press was scathing; contemporary cartoon commentary tended to focus on primate evolution, especially after the publication of Darwin's (1871) book, *The Descent of Man* (Quammen 2008). *Punch* relentlessly published many caricatures of Darwin, for example, one in 1861 entitled *Monkeyana* depicted a grotesque cartoon of an ape sporting a placard on which were the words: "Am I man and a brother?". Light satire focussed on Darwin was still being published by *Punch* in 1887, nearly thirty years after publication of *On the Origin of Species* (Quammen 2008). Not only did *Punch* lampoon Darwin, in 1881 Professor Huxley, (who was Inspector of Fisheries at the time), a long-time friend of Darwin, featured in *Punch's Fancy Portraits – No 23* where he is unflatteringly shown riding a fish and dubbed with the following caption: "There is more in heaven and earth, O ratio, than is dreamt of in *your* philosophy – (so *perhaps he'll find it in the rivers*)" (Quammen 2008).

The final years

The publication of *On the Origin of Species* did not mark the end of Darwin's investigation into natural selection as the mechanism for evolution. In the 1860s Darwin had been studying plant adaptations to attract insect pollinators, in particular orchids and their pollinators, to demonstrate how natural selection worked, that is, in the case of orchids there was a mutual dependence in which both insect and orchid exert selective pressure on the other. His research was published by John Murray on 15th May, 1862 in a book entitled: *The Various Contrivances by which British and foreign Orchids are Fertilized by Insects* (Darwin 1862).

In the 1870s Darwin's health, which had been poor for many years, improves. By this time evolution as descent

with modification had become accepted by most scientists, but few agreed that natural selection had been the main but not the exclusive means of modification (Bowler 2003). Darwin now turned his thoughts to the evolution of humans, a subject to which he only vaguely alluded in *On the Origin of Species. The Descent of Man, and Selection in Relation to Sex*, published in 1871, draws evidence from many sources that illustrated that humans were animals showing continuity of mental and physical attributes, an idea that would not have been well received at the time of publication of *On the Origin of Species* twelve years earlier. Darwin provided evidence to show that humans are all one species, and covered the subjects of sexual dimorphism, cultural racial characteristics, and the evolution of human culture (Darwin 1871).

Darwin published his last major work in 1881: *The Formation of Vegetable Mould, through the Action of Worms, with Observations on Their Habits* (Darwin 1881) about which Darwin commented: "... a subject of but small importance; and I know not whether it will interest any readers, but it has interested me" (Barlow 1958).

Charles Robert Darwin died on the 19th April, 1882 at his home, Down House, in Kent. He was honoured with a State funeral and is buried in the Nave at Westminster Abbey with other luminaries such as Ben Jonson, Isaac Newton, Robert Stevenson, David Livingstone, and Clement Attlee.

Afterword

This paper has focussed on the life of Charles Darwin, *the naturalist*, but it should not be forgotten that Darwin began his scientific career as a geologist. Geikie, at the Darwin Centennial Commemoration on 24th June, 1909, paid homage to Darwin when he delivered The Rede Lecture entitled: *Charles Darwin as Geologist* (Geikie 1909). He described Darwin as a man whose earlier years were devoted mainly to geological problems, and it was:

... from the side of geology that he was led into those evolution studies which have given him so just a title to our admiration and gratitude, and have placed him so high among the immortals (Geikie 1909)

This is fitting praise for a man who has contributed so much to the understanding of the world in which we live.

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